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PROCEEDINGS

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. VIII, PP. 1-24. MAY 3, 1906

MEXICAN, CENTRAL AMERICAN, AND CUBAN CAMBARI.

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WASHINGTON, D. C.

PUBLISHED BY THE ACADEMY

1906

207434

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MEXICAN, CENTRAL AMERICAN, AND CUBAN CAMBARI.

BY A. E. ORTMANN,

CARNEGIE MUSEUM, PITTSBURG, PA.

THE larger part of the material, upon which the following notes are based, was loaned to the writer by the Museum of Natural History of Paris through the kindness of Professor E. L. Bouvier, for which I wish to express my most sincere thanks. I am also under obligations to the Academy of Natural Sciences of Philadelphia, where I was granted the privilege of examining the crawfish-collections; some of this material has also been used for the following notes.

I. Subgenus **PARACAMBARUS**, new subgenus.

Paracambarus, new subgenus of Potamobiidæ (*Cambarus paradoxus*).

Sexual organs of male with the two parts in close apposition to their tips; in the male of the first form, both tips are shortly pointed and horny; in addition there is, on the posterior margin of the inner part, at a short distance from the tip, a long and strong, horny spine. Anterior margin of sexual organs without shoulder. Male with hooks on the ischiopodite of fourth pereiopods only. Female with a spiniform process on the sternum between the fifth pereiopods.

The presence of hooks only on the fourth pereiopods of the male, and the peculiar spine of the sternum of the female dis-

tinguish this subgenus at once from all other *Cambari*.[1] The male copulatory organs are also different from those of any other species of the genus, but they approach, to a certain degree, those of the subgenera *Procambarus* and *Cambarus*.

This is the sixth subgenus distinguished by the writer within the genus *Cambarus*.[2] It may be well to point out here the most important characters of these six subgenera by arranging them into a key.

KEY FOR THE SUBGENERA OF CAMBARUS.

a. Outer and inner part of male sexual organs in close apposition up to their tips; tips in the male of the first form horny or soft, with accessory horny spines.

b. Both tips of male organs horny; inner part with a strong accessory spine on posterior margin. Female with a spine on sternum between fifth pereiopods. Male with hooks on ischiopodite of fourth pereiopods..... *Paracambarus*.

bb. Both tips of male organs soft, with accessory horny spines on one of them. Female without spine on sternum between fifth pereiopods. Male with hooks on ischiopodite of third, or of third and fourth pereiopods.

c. Male organs with a small accessory spine, belonging to the inner part; anterior margin with a shoulder near the tips; male with hooks on third pereiopods..... *Procambarus*.

cc. Male organs with one to three horny accessory spines (often tuberculiform or plate-like), belonging to the outer part; shoulder generally absent, if present, remote from the tips; male with hooks on third, or on third and fourth pereiopods. *Cambarus*.

aa. Outer and inner part of male sexual organs distinctly separated for a more or less considerable distance at the tips; outer part, in the male of the first form, entirely transformed into a horny spine, rarely with a soft secondary spine.

d. Outer part of male organs consisting of two rather long spines, one horny, the other soft, bristle-like; male with hooks on second and third pereiopods..... *Cambarellus*.

dd. Outer part of male organs formed by one single horny spine;

[1] Except *Cambarus montezumæ* (subgenus *Cambarellus*).

[2] See Proc. Amer. Philos. Soc., XLIV, 1905, 96 and 97, and Ann. Carnegie Mus., III, 1905, 437.

male generally with hooks on third pereiopods, rarely on third and fourth pereiopods.

e. The two parts of the male organs shorter or longer, often very long, straight, divergent, or gently curved.....*Faxonius.*

ee. The two parts of the male organs with rather short, sharply recurved tips, forming about a right angle with the basal part. ..... *Bartonius.*

Paracambarus stands very isolated within the genus. We have regarded *Procambarus* as representing to a degree the old original stock of the genus. *Paracambarus* is more closely related to *Procambarus* than to any other subgenus, but there is no direct genetic connection imaginable. Although probably derived from common ancestors, each has apparently gone its own way of development, *Paracambarus* being rather extreme and one-sided in certain characters.

The only species, upon which this subgenus is founded, is new, and the description is as follows:

CAMBARUS (PARACAMBARUS) PARADOXUS, new species.

Diagnosis: Rostrum subovate, slightly concave above, margins converging, without marginal spines, contracted into a short, triangular acumen; carapace without lateral spines; areola wide, slightly longer than half of the anterior section of the carapace; first pereiopods with the chela subovate, swollen; palm subcompressed, covered with strong, subsquamose tubercles, which form, near the inner margin, two to three irregular, longitudinal rows; fingers longer than the palm, with tubercles at the bases, and a longitudinal rib on the outer faces; cutting edges with strong, irregular tubercles. Carpopodite granulated and tuberculated, spinose on inner and lower side. Only fourth pereiopods hooked in the male. First abdominal appendages of male with both parts in close apposition to the tips; tips horny in the male of the first form, both with a slight outward and backward curve; inner part on posterior side, a short distance from the tip, with a strong and long, spiniform process. Annulus ventralis, of the female forming an almost semicircular, transverse elevation, convex anteriorly, depressed

and concave posteriorly. Sternum between fifth pereiopods with a strong, triangular, anteriorly directed, spiniform process.

Description of adult male of first form:

Rostrum subovate, upper face slightly concave, margins elevated, converging, without marginal spines, contracted into a short, triangular acumen, which is shorter than the width of the rostrum at the base. *Postorbital ridges* subparallel, anteriorly without spines. *Carapace* rather compressed, covered with punctations, which are rather large on gastrical region and base of rostrum; sides of carapace finely granulated, granules more distinct on hepatical region. Suborbital angle blunt. Branchiostegal spine short, tuberculiform; cervical groove slightly sinuate; no lateral spines on the sides of the carapace; *areola* wide, with four to five irregular rows of punctations, slightly longer than half of the anterior section of the carapace (including rostrum).

Abdomen as wide as, and longer than, carapace; basal segment of telson with three or four spines on each side; posterior segment semicircular.

Epistoma with anterior part broadly triangular, sharply pointed in the median line; lateral margins concave anteriorly, convex posteriorly; *antennal scale* broad, greatest width anterior to the middle; flagellum rather short, reaching to the second or third abdominal segment.

First pereiopods rather stout; hand elongated-ovate, slightly compressed; surface with strong, subsquamiform tubercles, differing in color from the surface of the hand, being, in alcoholic specimens, bluish black, while the rest of the hand is brownish yellow; tubercles irregularly distributed, but with the tendency to form two or three rows near the inner margin, and slightly more crowded on the rounded outer margin of the hand; on under surface of hand, the tubercles are more remote from each other, and not colored differently from the surface. Fingers distinctly longer than the palm, slightly gaping at the bases, each with a smooth longitudinal rib on outer and inner face, included by rows of punctations; tubercles of palm extending upon bases of both fingers, and forming a short row upon proximal part of outer margin of movable finger; cutting edges with

irregular, strong tubercles; tips horny, and generally another horny tooth a short distance from tip on cutting edge of the immovable finger.

Carpopodite short, with a longitudinal sulcus above, granulated and tuberculated; tubercles forming one or two spines on distal end of inner margin, and two other spines on lower surface, one on anterior margin, the other at the lower articulation with the hand. Meropodite granulated, but almost smooth on the larger portion of outer and inner face; several strong tubercles at distal end of upper margin; inner and outer lower margins each with a row of strong, spiniform tubercles, the outer row shorter. All the tubercles of the chelipeds appear squamiform on account of a fringe of short, stiff hairs at their anterior edges.

Ischiopodite of fourth pereiopods with a strong hook; this hook has a subcompressed, broad base, and is subcompressed, but narrower at the tip, and is slightly twisted. The ischiopodite of the third pereiopods is without hook, and there is only a slight, almost imperceptible elevation at its inferior margin.

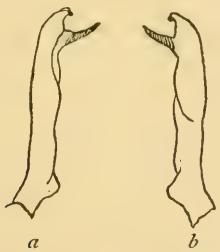

FIG. 1. *Cambarus paradoxus*, sp. n. First pleopod (right side) of male (I). *a*, outer view; *b*, inner view. Enlarged about four times.

First pleopods (see Fig. 1) reaching to the middle of the bases of the third pereiopods, stout, slightly curved backward; inner and outer parts subequal, in close apposition to the tips. Both tips curved gently backward, and slightly outward, horny; inner part, on posterior margin, at a short distance from the tip, with a strong, spiniform process, going off at an acute angle, and being longer than the two tips of this organ.

Male of the second form: Tips of inner and outer parts of

sexual organs, as well as the spiniform process, not horny; hook of fourth pereiopods smaller and weaker.

Female: Similar to the male, but chelæ not so strong. Annulus ventralis transversely semicircular, anterior margin convex, elevated, with a curved longitudinal fissure; posterior margin with a subtriangular depression. Sternum between the fifth pereiopods with a triangular, spiniform process, directed forward, which fits into the depression of the annulus.

Aside from the peculiarities offered by the subgeneric characters, this species is also remarkable for its chelæ, which differ in a number of features from the types of chelæ usually seen in the genus *Cambarus*.

Measurements:

The following are the dimensions of the three type-specimens: ♂ (I): total length 48 mm.; carapace 23; anterior part 15, posterior part 8; abdomen 25; hand 17, palm 7, fingers 10; width of hand 7. — ♂ (II): total length 48.5 mm.; carapace 23.5, anterior part 15.5, posterior part 8; abdomen 25; hand 16, palm 6.5, fingers 9.5; width of hand 6. — ♀: total length 48 mm.; carapace 23, anterior part 15, posterior part 8; abdomen 25; hand 15, palm 6.5, fingers 8.5; width of hand 6.

The largest ♂ (I) measures 51 mm., and the largest ♀ 54.5 mm.

Locality: Sierra de Zacapoaxtla, State of Puebla, Mexico.— L. Diguet coll. 1904 ("ruisseaux torrentueux des montagnes, a le cañada de Tetela de Ocampo"). (Mus. Paris, numerous specimens.)

II. CAMBARUS (PROCAMBARUS) PILOSIMANUS, new species.

Diagnosis: Rostrum subplane, with a marginal spine on each side; carapace with two lateral spines on each side; areola narrow, as long as, or longer than, half of the anterior section of the carapace; first pereiopods with the chela long, subcylindrical, slightly compressed, covered with tubercle-like granules; fingers about as long as the palm, each with a smooth longitudinal ridge on the outer side, for the rest densely pilose on

outer and inner sides, the hairs extending upon the distal part of the palm. (In young individuals, the pilosity is less marked or even absent.) Carpopodite and meropodite granulated, and with a few granules developed into sharp spines on the inner and lower sides (indistinct in old individuals); third pereiopods hooked in the male; first abdominal appendages of male with inner part pointed and straight, longer and much thinner than the broad and blunt outer part; shoulder of anterior margin only slightly developed; inner face flattened and only slightly dilated. Annulus ventralis of the female conically elevated.

Description of adult male of the first form:

Rostrum subplane, margins elevated, gradually convergent, slightly convex, chiefly so anteriorly, with a distinct marginal spine on each side a short distance from the tip; acumen triangular, rather short, shorter than width of rostrum at base; margins of acumen hairy; *postorbital ridges* subparallel, ending in a spine anteriorly; *carapace* compressed, thickly and finely punctate, and finely granulated on the sides; suborbital angle blunt; branchiostegal spine small; cervical groove sinuate, two lateral spines on each side behind the cervical groove; *areola* very narrow, but not obliterated, with one irregular row of punctations, longer than half of the anterior section of the carapace (including rostrum).

Abdomen about as long and as wide as the carapace; basal segment of telson with two (rarely three) spines on each side; posterior segment broadly rounded, short.

Epistoma with anterior part triangular, obtuse; *antennal scale* broad, broadest in the middle; flagellum longer than the carapace, but shorter than the whole body.

First pereiopods elongated, subcylindrical; hand elongated, slightly compressed, with subparallel margins, widest at the base of the fingers; surface thickly granulate, granules tuberculiform, rounded, very distinct, subequal; fingers about as long as the palm, both on outer faces with a smooth longitudinal ridge; for the rest, the fingers are thickly pilose on outer and inner side, the pilosity extending a short distance upon the palm on both faces; carpopodite subcylindrical, with an indistinct, longitudinal sulcus on upper side; granulated everywhere, gran-

ules largest on inner side; a granule each at the distal end of inner margin, on the anterior margin of inner side, and at distal end of lower margin, more strongly developed and subspiniform (often only indistinctly so); meropodite granulated, granules indistinct on outer and inner faces; a subspiniform one near distal end of upper margin, and several subspiniform ones on lower side (often indistinct).

Ischiopodite of third pair of pereiopods with a strong hook.

FIG. 2. *Cambarus pilosimanus*, sp. n. First pleopod (right side) of male (I). *a*, outer view; *b*, inner view. Enlarged about four times.

First pleopods (see fig. 2) rather short, straight; anterior margin with an indistinct, blunt shoulder near the tips; outer and inner part in close apposition to their tips; tip of outer part very blunt and rounded, slightly compressed in the anteroposterior direction; tip of inner part straight, thin and pointed, distinctly longer than outer part; at its base, on the anterior side, in front of the shoulder, there is a short, procurved, horny spine; inner part flattened on inner face, slightly dilated, with hairs radiating from an indistinct oblique rib.

Male of second form: The horny spine of the copulatory organs is replaced by a small, soft, blunt tubercle.

Young males (of first or second form), less than 50 mm. total length, differ in the areola, which is about as long as the anterior section of the carapace; chelipeds shorter and weaker, their granulations indistinct; they have short, scanty hairs, and the fingers are *not pilose;* carpopodite with well developed spines; meropodite also with sharp spines; one near distal end of upper margin, one at distal end of outer lower margin, and one or two at distal end of inner lower margin; besides,

there are one to three more, forming an irregular row in the middle of the lower side.

Female: Young females are like young males, older individuals have the pilosity of the fingers well developed, but the chelipeds are less elongated than in old males, and consequently comparatively broader. The spines of meropodite and carpopodite of the chelipeds also have the tendency to disappear in very old individuals. Annulus ventralis a blunt, low, subconical tubercle, with an S-shaped longitudinal fissure.

Measurements:

The following are the measurements of the two type-specimens: ♂ (I): total length 72 mm.; carapace 36, anterior section 23, posterior section 13; abdomen 36; length of hand 30, width of hand 8. ♀: total length 62 mm.; carapace 31, anterior section 20, posterior section 11; abdomen 31; length of hand 19, width of hand 6.

The largest females measure 68 mm.; the largest male is the above type.

Localities:

Types and Cotypes: Coche, près de la rivière de Coban, Guatemala.—Exped. du Mexique. Bocourt (Mus. Paris, 10 ♂ (I), 3 ♂ (II), 9 ♀).[1]

Belize, British Honduras. — Exped. du Mexique (Mus. Paris, 1 ♂ (I)).

Remarks: There is quite a difference in the features of old and young individuals. Generally, in specimens less than 45 mm. long, the pilosity of the fingers is not developed, and meropodite and carpopodite of the chelipeds possess sharp spines. There is a ♀, 45 mm. long, which shows traces of pilosity, while two males of the first form, of 49 and 50 mm. respectively, do not show it. The smallest male of the first form that has it, is 58 mm. long. Upward of this size all specimens have the fingers densely pilose. The spines of the chelipeds disappear entirely only in the oldest individuals; the smallest male (first

[1] I have not been able to locate this place, nor a river "Coban"; but Coban is the well-known capital of the province of Alta Vera Paz. The river at Coban is called Rio Cahabon. Coban, Alta Vera Paz, is the locality for a species of *Cambarus* mentioned by Huxley (1878).

form), in which they have disappeared, is 58 mm. long, but in another, 62 mm. long, they are still recognizable. Three other males of the first form, 69, 71, 72 mm., have no spines. In the females, the spines generally persist up to a size of 60 and 62 mm., but they are missing in two females of 62 and 68 mm. length.

Cambarus pilosimanus is closely allied to *C. williamsoni* Ortmann[1] from Los Amates, near Izabal, Guatemala. Indeed, it may be identical with it. The difference of the pilosity of the chelæ in old individuals of *C. pilosimanus* is very marked however, but we are to bear in mind that the largest individual of *C. williamsoni* was rather small (51.5 mm.). Aside from the pilosity of the chelæ, the only important difference noted is in the male copulatory organs, *C. pilosimanus* having the shoulder less developed, and the tips of the inner and outer part more strongly contrasted. But this difference is not necessarily specific, since for the rest the copulatory organs of both species are built according to the same plan. Other differences are only slight and apparently unimportant. In the young of *C. pilosimanus*, where the pilosity of the chelæ is not developed, the carpopodite and meropodite always possess a number of sharp spines, while in *C. williamsoni* only in the very young are traces of such spines visible on the meropodite. In specimens of about the same size, the granulations of the hand are more distinct in *C. williamsoni*, although in old individuals of *C. pilosimanus* the granules are much stronger than in any specimens of *C. williamsoni* that are known. Further, the hand of *C. pilosimanus* is comparatively less slender, and is broader than in *C. williamsoni*.

The close affinity, if not identity, of these two species is also borne out by the geographical distribution, but the two known localities of *C. pilosimanus* are farther north than that of *C. williamsoni*. It is quite possible that additional material will demonstrate their identity, but for the present I separate them, since there is no individual among the material from the province of Izabal that shows any trace of the pilosity of the chelæ.

[1] Ann. Carnegie Mus., III, 1905, 439.

III. CAMBARUS (PROCAMBARUS) MEXICANUS Erichson.

Literature: see Faxon, Mem. Mus. Harvard, 10, 1885, 50, and:

Camb. mex. Ortmann, Zoöl. Jahrb. Syst., 6, 1891, 12; — Faxon, Proc. U. S. Nat. Mus., XX, 1898, 649; — Hay, Amer. Natural., XXXIII, 1899, 959 and 964.

Camb. (*Cambarus*) *mex.* Ortmann, Proc. Amer. Philos. Soc., XLIV, 1905, 101.

Camb. (*Procambarus*) *mex.* Ortmann, Ann. Carnegie Mus., III, 1905, 438.

I have examined the male of the first form of this species preserved in the Philadelphia Academy, from Mirador, Mexico (already mentioned by Faxon). The copulatory organ belongs to the type of the subgenus *Procambarus* and is allied to that of *C. williamsoni* and *pilosimanus*. It differs in the very strongly developed shoulder, and the position of the horny, procurved spine, which is almost terminal on the inner part. The tips of inner and outer part resemble those of *C. williamsoni*.

An *additional locality* for this species is represented in the collections of the Philadelphia Academy:

Texolo, State of Vera Cruz, Mexico. — S. N. Rhoads coll. 1899. — 3 ♂ (II), 2 ♀. (Texolo is near Xico, on the branch road from Jalapa, distant about 15 miles from Jalapa.)

In the males of the second form of this set, the shoulder of the sexual organs is not quite so sharp, and the inner part is more pointed.

IV. CAMBARUS (PROCAMBARUS) CUBENSIS Saussure.

Literature: see Faxon, Mem. Mus. Harvard, X, 1885, 51, pl. 2, f. 1; pl. 8, f. 5, and:

Camb. cub. Faxon, Proc. U. S. Nat. Mus. 1885, 358; Hay, Amer. Natural., XXXIII, 1899, 959–963.

Camb. (*Cambarus*) *cub.* Ortmann, Proc. Amer. Philos. Soc., XLIV, 1905, 101.

Camb. (*Procambarus*) *cub.* Ortmann, Ann. Carnegie Mus., III, 1905, 438.

Among the material from the Paris Museum, sent to me by Professor Bouvier, the following specimens were present:

1. 1 ♂ (II), 2 ♀. Cuba; Peters.

2. 4 ♂ (II), 1 ♀. Cuba; Peters. (Nos. 1 and 2 apparently from the Berlin Mus.)

3. 2 ♂ (I), 2 ♂ (II), 4 ♀. "Amerique"; Morelet. (All badly damaged, but copulatory organs well preserved.)

4. 1 ♂ (I), type of Saussure's *C. consobrinus*. (Dry specimen, mounted upon a piece of pith; badly damaged, and copulatory organs not visible.)

The following remarks are to be made:

1. *C. consobrinus* Saussure[1] is undoubtedly identical with *C. cubensis*. Although in the present type-specimen the male organs are not visible, it agrees with *C. cubensis* in all other respects. It has a very small lateral spine on the carapace. But such a spine is also present in two specimens (♂ and ♀) in our first set, while the third (♀) has only a trace of it. In the five specimens of the second set, which are all very young, two males (II) have a small granule in its place; the others are apparently smooth. Of the eight specimens of the third set, one (a male of the first form) shows a small tubercle, and two females have none. The rest is too poorly preserved.

2. The *male copulatory organs* (Fig. 3, *a–c*) need some discussion. The description given by v. Martens (Arch. f. Naturg., 38, 1872, p. 129) is quite correct, disregarding a lapsus calami or misprint, that renders a certain passage unintelligible. V. Martens says (translated): They consist of two parts "an outer one, which ends in a blunt point, and has the anterior margin near this point considerably swollen; and an inner one, which extends beyond the former posteriorly, and forms on the inner side a plane, ovate face, *which is adjacent to that of the appendage of the* ANTERIOR *side* ('*welche sich an die des Anhanges der* VORDEREN *Seite anlegt*'). At its end there are two lobes, one in close apposition to the end of the outer part, the second one shorter, projecting separately forward, and more rounded."

[1] Rev. Mag. Zool. (2), 9, 1857, p. 101, and Mem. Soc. Geneve, 14, 1858, 457, pl. 3, f. 21.

The words emphasized by me cannot be understood as they stand. But if we conjecture that v. Martens wrote or intended to write, instead of *vorderen* (anterior), *anderen* (other), everything is clear: he meant to say, that the inner plane face of the inner part is adjacent to the identical face of the appendage of the *other* side.

Thus the whole description is intelligible, and indeed, it is a correct characterization of the chief features of this organ. It is very interesting to note, that already v. Martens attributes to the inner part two lobes, and his second one is clearly the accessory spine, which is not horny in the male of the second form; v. Martens, consequently, describes this organ of the male of the second form.

He has also correctly interpreted this organ. There is also in our specimens an outer part, which ends bluntly, and has the anterior margin slightly swollen just below the tip. The inner part is dilated and flattened on the inside, and forms, on the anterior margin, near the tip, a sharp shoulder. Its posterior margin extends considerably beyond the margin of the outer part, which is due to the extreme dilatation of the inner face. Its tip is pointed, and has, in the second form, a rounded, projecting lobe anteriorly.

In the male of the first form, the tip of the inner part is more slender and thin, almost setiform, but soft (not horny). The projecting lobe is replaced by a slightly procurved, horny spine, which is two-pointed, one point being blunt, the other acute and thin.

Faxon's figures (1885, pl. 8, f. 5, 5′, 5ᵃ, 5ᵃ′) are only partly correct. There is hardly any objection to Fig. 5ᵃ′, which represents the inner view of this organ of the left side of the male of the second form. It shows plainly the pointed tip of the inner part and the lobiform accessory process, as well as the thickened anterior margin of the tip of the outer part. Fig. 5ᵃ represents the same organ from the outside. The different parts are recognizable, but the outer part is not marked off at the tip, and the accessory lobe of the inner part is rendered incorrectly (as a recurved, blunt hook). Fig. 5′ is intended to represent the inner view of this organ of the left side in the male of the first

form; the inner part is drawn correctly, showing the setiform tip and the horny spine; this spine, however, is drawn triangularly-single-pointed, while it is really slightly procurved and two-pointed. The outer part is represented in this drawing by a blunt, conical process, while actually it resembles the condition seen in the male of the second form, being concealed by the inner part with the exception of the swollen anterior margin, which projects slightly. Fig. 5 (outer view of same organ) is

FIG. 3. *Cambarus cubensis* Sauss. *a*, First pleopod (left side) of male (II), outer view; *b*, the same, inner view; *c*, tip of same organ of male (I), inner view; *d*, annulus ventralis of female. All figures enlarged.

quite unintelligible; the tip of the outer part is not correctly represented, while the horny process is much too thin and is recurved, instead of procurved.

That the differences between Faxon's figures and our specimens are due to incorrect rendering of the object by the draughtsman, is evident from the fact that it is impossible to reconcile the different views (inner and outer) of the same object. Correct figures of the organ in question are submitted here.

Thus the copulatory organs of *C. cubensis* clearly belong to the type of the subgenus *Procambarus;* the outer part has no terminal horny teeth, but is soft and blunt; the inner part is flat-

tened and dilated on the inside, with a shoulder on the anterior margin near the tip; the end of the inner part has a soft tip, and, in addition, in the male of the first form, a horny spine, which is replaced, in the second form, by a blunt tubercle.

C. cubensis is closely allied to the species *williamsoni*, *pilosimanus*, and *mexicanus*, but differs in the following characters:

(1) The dilatation of the inner face of the male copulatory organ is much more pronounced; the tip of the inner part is more pointed, almost setiform, in the male of the first form; the horny spine is two-pointed. (2) The rostrum has marginal spines; these are also present in *C. williamsoni* and *pilosimanus*, but are absent in *C. mexicanus*. (3) The carapace has a small lateral spine, which is sometimes absent; this spine is always missing in *C. mexicanus*, while the other two species have two distinct lateral spines on each side.

3. Faxon's description of the *annulus ventralis* of the female (l. c., p. 52) is correct: "composed of a large anterior bilobed tubercle, and a smaller posterior tubercle." I only wish to add that the small posterior tubercle possesses the S-shaped longitudinal fissure commonly seen in *Cambarus*, and it seems to me that only this tubercle ought to be regarded as the annulus. I was able to observe the shape of the annulus only in the largest female of the first set; in all other females, which are small, it is very indistinct, a fact that has also been noticed by Faxon.

For the rest, this species has been well described by Faxon, but in the figure of the anterior part of the animal (*pl. 2, f. 1*), the marginal spines of the rostrum have been omitted. These spines are small, but present in all specimens at hand.

V. CAMBARUS (CAMBARUS) WIEGMANNI Erichson.

Camb. wiegm. Faxon, Mem. Mus. Harvard, X, 1885, 38 (literature). — Hay, Amer. Natural., XXXIII, 1899, 959 and 964.

Camb. (*Cambarus*) *wiegm.* Ortmann, Proc. Amer. Philos. Soc., XLIV, 1905, 102.

Hagen's female type specimen in the Philadelphia Academy agrees rather well with a *male of the first form* present in the same collection. This latter one is from the Cope collections and represents a new locality for the species:

Lake Xochimilco, south of City of Mexico (Federal District). —E. D. Cope coll., 1885.

This male has enabled me to draw up the following *description:*

Rostrum broad, moderately long, plane above; margins elevated, slightly convergent anteriorly, near the tip more strongly convergent, and forming a short, subtriangular acumen; no marginal spines nor marginal angles at base of acumen, and the elevated margins continued to the tip, which is bluntly pointed; postorbital ridges divergent posteriorly, without spines anteriorly; *carapace* ovate, slightly compressed, punctate, slightly granulated on the sides; suborbital angle blunt, branchiostegal spine distinct, but blunt (tuberculiform); cervical groove sinuate; no lateral spine; *areola* longer than half of the anterior section of carapace, rather narrow in the middle, with two to three irregular rows of punctations.

Abdomen as wide as, and slightly longer than, the carapace; anterior segment of telson with three spines on each side; posterior segment semicircular.

Epistoma with anterior part almost semicircular, a little angular on the sides, and bluntly pointed at the middle; *antennal scale* broad, broadest anterior to the middle; *flagellum* shorter than carapace (but damaged at end).

Chelipeds with hand rather wide, not much swollen, compressed, with subparallel margins; surface squamoso-tuberculate, tubercles on inner margin more crowded and stronger, forming an irregular row of serrations; fingers strong, about as long as the palm, with longitudinal ribs and punctations on outer face, and with squamiform tubercles at the bases; cutting edges tuberculated, tubercles irregular, a larger one near the base of each finger, and another large one near the distal end of immovable finger; carpopodite squamoso-tuberculate, inner side with several spiniform tubercles, upper surface with a slight longitudinal sulcus; meropodite smooth, with a few tubercles near distal end of upper margin, and two rows of tubercles on lower margins, the outer ones shorter.

Ischiopodite of third and fourth pereiopods with hooks, those of the third pereiopod are very small, but distinct and tubercu-

liform. Those of the fourth pereiopod very strongly developed, swollen and inflated, tapering to a blunt point; *coxopodite* of third pereiopod with a semicircular, elevated, compressed tubercle, that of the fourth pereiopod with a strong, triangular spine, directed outward; that of the fifth pereiopod with a small, spiniform tubercle below genital opening, directed downward.

FIG. 4. *Cambarus wiegmanni* Erichson. First pleopod (right side) of male (I). *a*, outer view; *b*, inner view. Enlarged about three times.

First pleopods (Fig. 4) rather long and slender for the subgenus *Cambarus*, reaching to the coxopodites of the second pereiopods, almost straight, very slightly curved; truncated at the tip, with three horny teeth, of which the outer one is compressed and truncated, crescentic in shape; the inner tooth is broadly triangular, and the anterior is short and spiniform,[1] the inner part of this organ terminating in an almost straight spine, which is only slightly directed outward, and is slightly longer than the truncated outer part, and has a distinct horny tip.

Measurements: Total length 60 mm.; carapace 29, anterior part of carapace 18.5, posterior 10.5; width of areola 1.75; abdomen 31; length of hand 25.5, width of palm 9.5 (Erichson gives the following figures: total length 52 mm., length of hand 17 mm., width of hand 6.5 mm. Hagen gives 66 mm. as total length.)

Comparing the present male with the description of the spe-

[1] This latter one seems to belong to the inner part; but I suspect strongly that such is the case also in other species of the subgenus. The homologies of the sexual organs of *Cambarus* are altogether not well understood, and urgently need a more close study.

cies given by Erichson, and the discription of the female given by Hagen, there is hardly any difference. Hagen describes and figures the epistoma as triangular and rather acute, which is not the case in our individual, and further, Hagen gives only two lateral spines for the anterior section of the telson. These differences are of no consequence, variations in these characters being frequent in other species. I have compared the female in Philadelphia, which served as the base of Hagen's description, and which, since the Berlin types of Erichson have disappeared, must be regarded as the type of the species, and I find it to agree in all essential characters with our male, chiefly so in the shape of body and rostrum. Thus I think, the present male ought to be referred to this species.

As is evident from the characters of the male of the first form described above, *C. wiegmanni* belongs to the subgenus *Cambarus*, to the section of *C. blandingi*, and the group of *C. alleni*,[1] and it has been assigned its correct position already by Hagen and Faxon (allied to *C. barbatus*). The sexual organs are peculiar on account of the crescentic, compressed and truncated outer horny tooth, and do not closely agree with any of the known species of the subgenus; but just this feature agrees with the *alleni*-group in so far as this group is characterized by peculiar and aberrant conformations of the tips of the sexual organs.[2] In shape of carapace, areola and rostrum, this species agrees closely with *C. evermanni*, *barbatus* and *alleni*, and the rostrum represents a rather advanced stage of development, being broadly lanceolate, without any traces of marginal spines or even marginal angles in their place. It resembles to a certain degree, the rostrum of *C. clypeatus* Hay[3] from Bay St. Louis, Hancock Co., Miss., but in the latter form the rostrum is still broader, and almost rounded off at the apex. I should

[1] See Ortmann, Proc. Amer. Phil. Soc. 1905, 98 and 100; Ann. Car. Mus., 1905, 437 and 438.

[2] The sexual organs agree most nearly with those of *C. hinei* Ortm. from Louisiana, with the exception that in the latter species the crescentic and truncated tooth is absent, and that the distal part of the organ is distinctly curved backward. See Ortmann in The Ohio Naturalist, VI, 1905, p. 402, fig. 1. Also the rostrum of *C. hinei* is transitional toward *C. wiegmanni*.

[3] Proc. U. S. Nat. Mus., XXII, 1899, 122, fig. 2, no. 1.

not be surprised, if this latter species, of which the male is unknown, should finally prove to belong to this group, and not to the second group of Faxon (affinity of *C. cubensis*) as Hay is inclined to believe.

The hooks of the ischiopodites of the pereiopods are very peculiar, and unlike anything else that is known in the genus. And further, the development of the spines and processes of the coxopodites of the three last pairs of pereiopods is very unique; such processes are indeed found in other species in the shape of tubercles or ridges on the fourth or fifth pereiopods, but they never assume such proportions as in this species, and the outwardly directed spine of the coxopodite of the fourth pereiopod in *C. wiegmanni* is without parallel.

Thus it seems that *C. wiegmanni* is to be regarded as a very peculiar, and, in certain features, extremely developed form of the subgenus *Cambarus*, which belongs to a rather advanced and modern group of it (*alleni*-group, see l. c., p. 105) which is characteristic for those parts of the coastal plain of the southern United States, that are most recent geologically. Its presence in Mexico is rather interesting, and the specialized character points to a recent immigration into these parts. But we are to bear in mind that the *alleni*-group in general is comparatively poorly known and needs further study.

VI. Subgenus **CAMBARELLUS.**

For the species of this subgenus I am only able to add a few new locality records:

Cambarus (*Cambarellus*) *montezumæ* Saussure (Faxon, 1885, 121; 1898, 660).

Neighborhood of City of Mexico: Laguna de Santa Isabel. — G. Seurat coll., 1897 (Mus. Paris, 1 ♂ (I), 1 ♀).

Mexico. — Mus. Paris, numerous specimens, collected by various persons, but without more explicit localities.

Lake Xochimilco, south of City of Mexico (Federal District). E. D. Cope coll., 1885 (Philadelphia Academy, 1 ♀).

Most of the specimens seen by the writer belong to the form *tridens* v. Mart. With Faxon, I do not believe that this is worth a varietal name. According to my observations, young

examples generally are *tridens*, while the typical form is found only among old individuals, and is comparatively rare.

Cambarus (*Cambarellus*) *montezumæ dugesi* Faxon (1898, 660, *pl. 66, f. 1*).

Guadalajara, State of Jalisco, Mexico. — Diguet coll. (Mus. Paris; many specimens).

Same locality. — Dugès coll. (Mus. Paris, 4 ♂).

State of Guanajuato, Mexico. — Diguet coll. (Mus. Paris, 4 ♂, 4 ♀).

The latter locality is the type-locality recorded by Faxon. The specimens from Guadalajara have been mentioned by Bouvier as *C. montezumæ tridens* (Bull. Mus. Paris, 1897, 224), but they clearly belong to this variety.

Cambarus (*Cambarellus*) *montezumæ occidentalis* Faxon, (1898, 661, *pl. 66, f. 3, 4*).

Hot Springs, Huingo, State of Michoacan, Mexico. — S. N. Rhoades coll., 1899 (Philadelphia Academy; many specimens).[1]

VII. SYNOPSIS OF THE CRAWFISH-FAUNA OF MEXICO, CENTRAL AMERICA AND THE WEST INDIES.

Our knowledge of the chorology of the genus *Cambarus*, south of the United States, is rather poor. Crawfish are now known from Mexico, Guatemala, British Honduras, and Cuba, but not only is the morphology of these forms not well understood, but also we have only a few and often doubtful or unreliable locality-records. In order to call attention to this lack in our knowledge, I want to condense here the known facts, and point out the questionable records.

Four subgenera are represented in this southern section of the range of the genus: *Paracambarus*, *Procambarus*, *Cambarus*, *Cambarellus*. The first two are not found in the United States, while the other two are. *Cambarus* is largely distributed in the United States, and has its main range there, only one species having invaded Mexico. *Cambarellus* has its main abode in Mexico, and only one species is known from a single locality in Louisiana (New Orleans).

[1] Huingo is near Lake Cuitzeo, and site of large salt works by evaporation from natural springs flowing into the lake. Crawfish were numerous in these springs and streams (communication from Mr. S. N. Rhoades to the writer).

The following is a list of the known species and their distribution:

1. *Cambarus* (*Paracambarus*) *paradoxus* Ortmann.

Tetela, Sierra de Zacapoaxtla, State of Puebla, Mexico.

2. *Cambarus* (*Procambarus*) *digueti* Bouvier.

Tributaries of Rio Santiago, State of Jalisco, Mexico (Bouvier).

Guadalajara, State of Jalisco (Faxon).

Ameca, State of Jalisco (Faxon).

Hacienda de Villachuato, State of Michoacan (Faxon). The location of this hacienda is unknown.

This species consequently belongs to the Pacific drainage in western Mexico.

3. *Cambarus* (*Procambarus*) *williamsoni* Ortmann.

Los Amates, Province of Izabal, Guatemala (Atlantic drainage).

4. *Cambarus* (*Procambarus*) *pilosimanus* Ortmann.

Coche, on river Coban, Guatemala (probably Coban, Province of Alta Vera Paz, see above p. 9, footnote).

Belize, British Honduras. (Both localities in Atlantic drainage.)

5. *Cambarus* (*Procambarus*) *mexicanus* Erichson.

Mexico (Erichson, Ortmann). Probably the City of Mexico is meant, since the presence of this species in its neighborhood is confirmed by other records from the Federal District.

Santa Maria, Mexico (Faxon). There are half a dozen places of this name in various parts of Mexico. One is close to the City of Mexico, and thus we may assume that this is intended.

Tomatlan, Mexico, "terres chaudes" (Saussure). Again there are several places of this name in Mexico: one is south of the City of Mexico, in the Federal District, another in the State of Jalisco, not far from the Pacific Ocean; a third one about 10 miles south of Huatusco, in the State of Vera Cruz. Saussure's specification: "terres chaudes" renders it safe to assume that this latter locality in the State of Vera Cruz was intended.

Puebla, State of Puebla (v. Martens).

Mirador, Mexico (Faxon). This is an observation station in the State of Vera Cruz, 19° 15′ N., 96° 40′ W., alt. 3,600 feet. I was not able to find it on any of the maps at my disposal.

Texolo, State of Vera Cruz (see above p. 11).

Thus this species is known from the states of Mexico (Federal District), Puebla, and Vera Cruz, that is to say, from the central plateau and from the Atlantic slope.

6. *Cambarus* (*Procambarus*) *cubensis* Erichson.

Cuba. Saussure gives the interior of this island, and Faxon creeks in a little town opposite Havana.

7. *Cambarus* (*Cambarus*) *wiegmanni* Erichson.

Mexico (Erichson, Hagen), probably the City of Mexico.

Lake Xochimilco, Federal District (see above, p. 16).

Jalapa, Mexico (Faxon). This is very likely Jalapa in the State of Vera Cruz, although there are other places of this name in Mexico.

These localities are on the central plateau and the Atlantic slope. This species has been recorded with some doubt from the Isthmus of Tehuantepec (Faxon), but we would better drop this for the present.

8. *Cambarus* (*Cambarellus*) *chapalanus* Fax.

Lake Chapala, State of Jalisco, Mexico (Pacific drainage).

9. *Cambarus* (*Cambarellus*) *montezumæ* Sauss.

a. Typical form (including var. *tridens* v. Mart.).

Chapultepec, Federal District, Mexico (Saussure). West of City of Mexico.

Lake Texcoco, Federal District (Faxon). East of City of Mexico.

Lake Xochimilco, Federal District (see above, p. 19). South of City of Mexico.

Laguna de Santa Isabel, near City of Mexico (see above, p. 19). I have not been able to locate this, but the statement that it is near the City of Mexico associates this with the first three records given.

Puebla, State of Puebla, Mexico (v. Martens).

Lake San Roque, Trapuato, Mexico (Faxon). I have not been able to find this locality designated on any of the maps, or in any gazetteer consulted by me.

Vera Cruz, Mexico (Ortmann) (Zool. Jahrb. Syst., 6, 1891, p. 12). This locality should be considered as doubtful till confirmed. The specimens upon which this record was founded,

were secured from a dealer, and it was not stated whether the city or the state of Vera Cruz was meant. Moreover, it is well known how utterly untrustworthy dealers' localities are.

The presence of this species in its typical form is thus positively known only on the central plateau, near the cities of Mexico and Puebla.

b. Cambarus (*Cambarellus*) *montezumæ dugesi* Faxon.

State Guanajuato, Mexico (Faxon, Mus. Paris).

Guadalajara, State of Jalisco (Bouvier, Mus. Paris, see above, p. 20).

Pacific drainage.

c. Cambarus (*Cambarellus*) *montezumæ areolatus* Faxon.

Parras, State of Coahuila, Mexico (Faxon). Northern part of central plateau.

d. Cambarus (*Cambarellus*) *montezumæ occidentalis* Faxon.

Mazatlan, State of Sinaloa, Mexico (Faxon).

Huingo, State of Michoacan, Mexico (see above, p. 20).

Pacific drainage.

It is hard at present to draw any conclusions from these meagre records. Only a few remarks may be made, but it is very likely that they will be subject to revision when more information comes to hand.

The subgenus *Procambarus* possesses its most primitive form (*C. digueti*) in the western extremity of its range (mountainous region toward the Pacific slope). The most extreme species (*C. cubensis*) is found at the eastern extremity of the range, in Cuba. Intermediate forms are found on the central plateau and the eastern hot country of Mexico (*C. mexicanus*), in Guatemala, and British Honduras (*C. williamsoni* and *pilosimanus*), thus indicating the direction of the dispersal (see Ortmann, Ann. Carn. Mus., 3, 1905, p. 441).

Thus *Procambarus* not only points out the original home of the genus in a general way (Mexico), but indicates especially the western portions of this country. However, further research is very desirable.

Cambarus wiegmanni is the only representative of the subgenus *Cambarus* in Mexico; the bulk of this subgenus being found in the United States, chiefly in the southern parts (see

Ortmann, P. Amer. Philos. Soc., 44, 1905, p. 103 f.). Moreover, it belongs to a rather advanced and modern group of this subgenus (*alleni*-group), which is characteristic for the late Tertiary and Post-tertiary plains of the South Atlantic and Gulf border in the United States. Thus it is very probable, that this species immigrated into Mexico from the United States, representing a direction of dispersal opposite to that generally observed in the genus, for which, however, at least one other instance is known (*C. clarki*, l. c., p. 126). The known habitat of *C. wiegmanni* appears rather isolated, and it is much to be desired that northern Mexico and southern Texas should be investigated with a view to settle this question.

The most primitive species of the subgenus *Cambarellus* (*C shufeldti*) is found in Louisiana. *C. chapalanus* appears slightly more primitive compared with *C. montezumæ* and its varieties, and is found in western Mexico. Of the *montezumæ* forms, *areolatus* is the most primitive and the most northern, nearest to the United States, while *occidentalis* is the most advanced (shape of rostrum), and is western in Mexico. Thus the evidence is partly contradictory. Leaving out *chapalanus*, the general trend of the evidence is to show that the subgenus originated in the southern United States and immigrated into Mexico, first into the central plateau, then into the Pacific slope.

This would, consequently, offer a third case of reversed migration in this region, and my map (1905, pl. 3) should be changed accordingly (the brown color). This would also not conflict with the morphological characters of *Cambarellus*, the shape of the sexual organs inclining more toward the subgenus *Faxonius* of the United States, than toward the Mexican subgenera. But I must confess, that the evidence for this assumption appears at present too scanty, so that we can hardly call it more than a mere theory. It is chiefly with a view to instigate further research on these questions that I have ventured to express at all an opinion on this topic.

M.I.R. JUN 26 1913

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